



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Patent Application of

DOTTA et al

Atty. Ref.: 1035-506

Serial No. 10/828,475

TC/A.U.: 2811

Filed: April 21, 2004

Examiner: Nadav, O.

For: SEMICONDUCTOR APPARATUS HAVING PENETRATION
ELECTRODE

May 21, 2007

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF

Sir:

Applicant hereby appeals to the Board of Patent Appeals and Interferences from the last
decision of the Examiner.

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(I) REAL PARTY IN INTEREST

The real party in interest is Sharp Kabushiki Kaisha, a corporation of the country of Japan.

(II) RELATED APPEALS AND INTERFERENCES

The appellant, the undersigned, and the assignee are not aware of any related appeals, interferences, or judicial proceedings (past or present), which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

(III) STATUS OF CLAIMS

Claims 1, 2, 4-9 and 17-28 are pending. Claims 3 and 10-16 have been canceled. Claims 1, 2, 4-9, 17-22, 24-26 and 28 stand rejected and are on appeal herein.

Claims 23 and 27 have been indicated as including allowable subject matter and would be allowable if rewritten in independent form. Because claims 23 and 27 are allowable, these claims are not on appeal herein.

(IV) STATUS OF AMENDMENTS

No amendments have been filed since the date of the Final Rejection. The Response After Final dated December 26, 2006 has been considered by the Examiner.

(V) SUMMARY OF CLAIMED SUBJECT MATTER

This section is for purposes of example only and without limitation.

Claim 1, for example and without limitation, semiconductor apparatus, comprising: a semiconductor substrate [e.g., element 1 in Fig. 1; pg. 16, line 17]; a field oxide film [e.g., element 2 in Fig. 1; pg. 16, line 18; pg. 17, line 13] formed over a surface of the semiconductor substrate, the field oxide film having an aperture section; a pad electrode [e.g., element 4 in Fig. 1; pg. 16, lines 20-21; pg. 17, line 14] having an aperture section formed therethrough, the pad electrode being formed over the field oxide film [e.g., element 2 in Fig. 1; pg. 16, line 18; pg. 17, line 13] so as to overlap the field oxide film when perpendicularly viewing the semiconductor substrate; and a penetration electrode [e.g., element 15 in Fig. 1; pg. 17, lines 7-8] electrically connected to the pad electrode, the penetration electrode [e.g., element 15 in Fig. 1; pg. 17, lines 7-8] being provided so as to pass through each of (a) the aperture section of the field oxide film, (b) a hole formed in the semiconductor substrate, and (c) the aperture section of the pad electrode [e.g., element 4 in Fig. 1; pg. 16, lines 20-21; pg. 17, line 14], the hole in the semiconductor substrate being formed entirely within the aperture section of the field oxide film [e.g., element 2 in Fig. 1; pg. 16, line 18; pg. 17, line 13], when perpendicularly viewing the semiconductor substrate, so that an opening of the hole is smaller than the aperture section of the field oxide film [e.g., element 2 in Fig. 1; pg. 16, line 18; pg. 17, line 13].

For purposes of example and without limitation, Fig. 1 of the instant application illustrates a pad electrode 4 formed over the field oxide film 2 so as to overlap the field oxide film 2 when perpendicularly viewing the semiconductor substrate, and a penetration electrode 15 electrically connected to the pad electrode 4. In example Fig. 1, the penetration electrode 15 is provided so as to pass through each of (a) the aperture section of the field oxide film 2, (b) a hole formed in the semiconductor substrate 1, and (c) the aperture section of the pad electrode 4. The cited art to Hayakawa fails to disclose or suggest this combination of features.

Claim 18, for example and without limitation, relates to a penetration electrode for use in a semiconductor apparatus, the semiconductor apparatus comprising a semiconductor substrate [e.g., element 1 in Fig. 1; pg. 16, line 17], a field oxide film [e.g., element 2 in Fig. 1; pg. 16, line 18; pg. 17, line 13] formed over a surface of the semiconductor substrate [e.g., element 1 in Fig. 1; pg. 16, line 17], the field oxide film having an aperture section that is an opening through the field oxide film, and a pad electrode [e.g., element 4 in Fig. 1; pg. 16, lines 20-21; pg. 17, line 14] formed over the field oxide film [e.g., element 2 in Fig. 1; pg. 16, line 18; pg. 17, line 13] so as to overlap the field oxide film when perpendicularly viewing the semiconductor substrate; wherein: the pad electrode has an aperture section formed therethrough, the penetration electrode [e.g., element 15 in Fig. 1; pg. 17, lines 7-8] is electrically connected to the pad electrode [e.g., element 4 in Fig. 1; pg. 16, lines 20-21; pg. 17, line 14], the penetration electrode being provided so as to pass through each of the aperture section of the field oxide film, a hole formed in the semiconductor substrate, and the aperture section of the pad electrode, the hole being formed entirely within the aperture section of the field oxide film, when perpendicularly viewing the semiconductor substrate [e.g., element 1 in Fig. 1; pg. 16, line 17], so that an opening of the hole is smaller than the aperture section of the field oxide film; and the penetration electrode being formed in a field area of the surface of the semiconductor substrate.

Claim 19, for example and without limitation, relates to a penetration electrode for use in a semiconductor apparatus, the semiconductor apparatus comprising: a semiconductor substrate [e.g., element 1 in Fig. 1; pg. 16, line 17], a field oxide film [e.g., element 2 in Fig. 1; pg. 16, line 18; pg. 17, line 13] formed over a surface of the semiconductor substrate [e.g., element 1 in Fig. 1; pg. 16, line 17], the field oxide film having an aperture section that is an opening through the field oxide film, a pad electrode [e.g., element 4 in Fig. 1; pg. 16, lines 20-21; pg. 17, line 14], having an aperture section formed therethrough, the pad electrode being formed over the field oxide film so as to overlap the field oxide film [e.g., element 2 in Fig. 1; pg. 16, line 18; pg. 17,

line 13] when perpendicularly viewing the semiconductor substrate; wherein: the penetration electrode is electrically connected to the pad electrode, the penetration electrode [e.g., element 15 in Fig. 1; pg. 17, lines 7-8] being provided so as to pass through each of the aperture section of the field oxide film, a hole formed in the semiconductor substrate, and the aperture section of the pad electrode [e.g., element 4 in Fig. 1; pg. 16, lines 20-21; pg. 17, line 14], and the hole being formed entirely within the aperture section of the field oxide film, when perpendicularly viewing the semiconductor substrate, so that an opening of the hole is smaller than the aperture section of the field oxide film.

Claim 28, for example and without limitation, relates to a semiconductor apparatus, comprising: a semiconductor substrate [e.g., element 1 in Fig. 1; pg. 16, line 17]; a field oxide film formed over a surface of the semiconductor substrate, the field oxide film [e.g., element 2 in Fig. 1; pg. 16, line 18; pg. 17, line 13] having an aperture section; a pad electrode [e.g., element 4 in Fig. 1; pg. 16, lines 20-21; pg. 17, line 14] formed over the field oxide film so as to overlap the field oxide film when perpendicularly viewing the semiconductor substrate; and a penetration electrode electrically connected to the pad electrode, the penetration electrode [e.g., element 15 in Fig. 1; pg. 17, lines 7-8] being provided so as to pass through each of the aperture section of the field oxide film [e.g., element 2 in Fig. 1; pg. 16, line 18; pg. 17, line 13], and a hole formed in the semiconductor substrate, and wherein the hole in the semiconductor substrate is formed entirely within the aperture section of the field oxide film, when perpendicularly viewing the semiconductor substrate, so that an opening of the hole is smaller than the aperture section.

(VI) GROUND OF REJECTION TO BE REVIEWED ON APPEAL

1. Whether or not claims 1-2, 4, 7, 9, 17-21 and 28 are anticipated under Section 102(e) by Hayakawa (US 6,450,621).

2. Whether or not claims 5-6, 8, 22 and 24-26 are obvious under Section 103(a) over Hayakawa in view of Finnila (US 5,426,072).

(VII) ARGUMENT

It is axiomatic that in order for a reference to anticipate a claim, it must disclose, teach or suggest each and every feature recited in the claim. See, e.g., *Kalman v. Kimberly-Clark Corp.*, 713 F.2d 760, 218 USPQ 781 (Fed. Cir. 1983). The USPTO has the burden in this respect.

Moreover, the USPTO has the burden under 35 U.S.C. Section 103 of establishing a *prima facie* case of obviousness. In *re Piasecki*, 745, F.2d 1468, 1471-72, 223 USPQ 785, 787-88 (Fed. Cir. 1984). It can satisfy this burden only by showing that some objective teaching in the prior art, or that knowledge generally available to one of ordinary skill in the art, would have led that individual to combine the relevant teachings of the references to arrive at the claimed invention. In *re Fine*, 837 F.2d 1071, 1074, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). Before the USPTO may combine the disclosures of the references in order to establish a *prima facie* case of obviousness, there must be some suggestion for doing so. In *re Jones*, 958 F.2d 347 (Fed. Cir. 1992). Even assuming, *arguendo*, that a given combination of references is proper, the combination of references must in any event disclose the features of the claimed invention in order to render it obvious.

Furthermore, with respect to the inherency rejections, the law is clear that for something to be “inherent” in a reference, it must “necessarily” be present. In *re Robertson*, 169 F.3d 743, 745, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999). The fact that a certain result or characteristic “may” occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic. In *re Rijckaert*, 9 F.3d 1531, 1534, 28 USPQ2d 1955, 1957 (Fed. Cir. 1993). The Board of Appeals has made clear that “[i]n relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art.” *Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990) (emphasis in original).

A. Section 102(e) Rejection Based on Hayakawa (claims 1-2, 4, 7, 9, 17-21, 28)

Claim 1

Claim 1 stands rejected under Section 102(e) as being allegedly anticipated by Hayakawa (US 6,450,621). This Section 102(e) rejection should be reversed for at least the following reasons.

Claim 1 requires “a penetration electrode electrically connected to the pad electrode, the penetration electrode being provided so as to pass through each of (a) the aperture section of the field oxide film, (b) a hole formed in the semiconductor substrate, and (c) the aperture section of the pad electrode, the hole in the semiconductor substrate being formed entirely within the aperture section of the field oxide film, when perpendicularly viewing the semiconductor substrate, so that an opening of the hole is smaller than the aperture section of the field oxide film.” For purposes of example and without limitation, Fig. 1 of the instant application illustrates a pad electrode 4 formed over the field oxide film 2 so as to overlap the field oxide film 2 when perpendicularly viewing the semiconductor substrate, and a penetration electrode 15 electrically connected to the pad electrode 4. In example Fig. 1, the penetration electrode 15 is provided so as to pass through each of (a) the aperture section of the field oxide film 2, (b) a hole formed in the semiconductor substrate 1, and (c) the aperture section of the pad electrode 4. The cited art to Hayakawa fails to disclose or suggest this combination of features.

The Advisory Action dated January 24, 2007 and the Office Action dated September 26, 2006 rely on Figs. 13B and 17 of Hayakawa, and contends that 21 in Hayakawa is the “pad electrode” and that 51 is the “penetration electrode.” Appellant notes that the Advisory Action admits that “32” in the Office Action was a typographical error and that “32 cannot be a pad electrode.” This rejection is flawed for a number of reasons.

First, claim 1 requires that *the penetration electrode must pass through an aperture section of the pad electrode*. However, the alleged penetration electrode 51 in Hayakawa does

not “pass through” an aperture section of the alleged pad electrode 21 (see Figs. 12 and 13B) as required by claim 1. Alleged penetration electrode 51 in Hayakawa is entirely below layer 19, while the alleged pad electrode 21 is entirely above layer 19 – there is no way in which the alleged penetration electrode 51 can be said to “pass through” the alleged pad electrode 21 as required by claim 1.

The *American Heritage Dictionary*, Third Edition (1994), defines “through” as: “[i]n one side and out another side of.” Thus, it is clear that according to claim 1 the penetration electrode must pass in one side and out another side of the pad electrode. Hayakawa fails to disclose or suggest this. The Examiner’s argument on page 3 of the Advisory Action dated January 24, 2007 that “the broad recitation of the claim does not require the penetration electrode to pass through the entire length of the aperture section” is unreasonable and contrary to the well-established meaning of “through.” The Examiner’s alleged interpretation of “through” is directly contrary to the definition provided by The *American Heritage Dictionary*, cited above. For example, the phrase “a train passed through a tunnel” would never be interpreted as including the case where a train entered a tunnel and stopped half-way through the tunnel. Likewise, there is no way that the alleged penetration electrode 51 can be said to “pass through” the alleged pad electrode 21 in Hayakawa.

Moreover, in Hayakawa, the alleged penetration electrode 51 and the alleged pad electrode 21 are located on entirely different planes (see Figs. 12 and 13B). In particular, alleged penetration electrode 51 in Hayakawa is entirely below layer 19, while the alleged pad electrode 21 is entirely above layer 19 – there is no way in which the alleged penetration electrode 51 can be said to “pass through” any alleged aperture of the alleged pad electrode 21 as required by claim 1 because the two elements are on entirely different planes. The alleged penetration electrode 51 does not extend into any part of any alleged aperture of the alleged pad electrode 21 in Hayakawa. The reference is entirely unrelated to the invention of claim 1 in this respect.

Second, claim 1 also requires that the *penetration electrode passes through a hole formed in the semiconductor substrate*. The Office Action does not identify the alleged hole in the semiconductor substrate. Moreover, the alleged penetration electrode 51 in Hayakawa does not “pass through” any hole in semiconductor substrate 1. Fig. 13B of Hayakawa makes clear that the alleged penetration electrode 51 in Hayakawa does not “pass through” any hole in any semiconductor substrate.

The Examiner’s argument on page 3 of the Advisory Action dated January 24, 2007 that “the broad recitation of the claim does not require element 51 to pass through the entire thickness of the semiconductor substrate” is unreasonable and contrary to the well-established meaning of “through.” The Examiner’s alleged interpretation of “through” is directly contrary to the definition provided by *The American Heritage Dictionary*, cited above. For example, the phrase “a train passed through a tunnel” would never be interpreted as including the case where a train entered a tunnel and stopped half-way through the tunnel. Moreover, Fig. 13B of Hayakawa makes clear that the alleged penetration electrode 51 does not even extend into any portion of semiconductor substrate 1. Again, the cited reference is entirely unrelated to the claimed invention in this respect and cannot possibly anticipate the same.

Third, claim 1 recites “a pad electrode, having an aperture section formed therethrough.” Hayakawa fails to disclose or suggest this. The Office action contends that this is met by Hayakawa’s adjacent inkjets each including electrode 21. However, at best, this teaches a plurality of electrodes – but cannot be the claimed pad electrode because there is no aperture section formed therethrough as required by the claim. One skilled in the art would not consider element 21 in Hayakawa to be a pad electrode with an aperture section formed therethrough. With respect to the Examiner’s argument in the Advisory Action, there is no “pad electrode layer” claimed. While 21 may be a pad electrode layer including a plurality of electrodes, it is not a pad electrode with an aperture section formed therethrough. The openings in 21 in

Hayakawa must complete separate the individual electrodes 21, since each ink jet head is separately activated. Because the individual elements 21 are completely separated from one another, 21 cannot be reasonably said to be a pad electrode having an aperture section formed therethrough as called for in claim 1.

Fourth, claim 1 requires “*the hole in the semiconductor substrate being formed entirely within the aperture section of the field oxide film, when perpendicularly viewing the semiconductor substrate, so that an opening of the hole is smaller than the aperture section of the field oxide film.*” The only hole in the semiconductor substrate 1 in Hayakawa appears to be the hole between openings 27 and 28 in Fig. 14. However, this hole in semiconductor substrate 1 of Hayakawa is not formed entirely within an aperture section of the alleged field oxide film 15 as viewed perpendicularly (as viewed from above).

The Examiner clarified in the Advisory Action dated January 24, 2007 that the alleged penetration electrode in Hayakawa is element 51 at the left side of Fig. 13B. In Fig. 13B of Hayakawa, the field oxide is not numbered but is located, *inter alia*, under elements 52 and 18. The alleged hole 27, 28 in the substrate 1 (see Fig. 14) is clearly much *larger* (not smaller as required by claim 1) than the hole in the field oxide shown in Fig. 13B through which element 51 extends. Moreover, there is no hole in the semiconductor substrate in Fig. 13B that is within any aperture of the field oxide film.

Furthermore, the hole 27, 28 in the substrate 1 shown in Fig. 14 of Hayakawa cannot be the claimed hold because there is no penetration electrode passing therethrough as required by claim 1. Accordingly, *assuming arguendo* that opening 27 in Fig. 14 of Hayakawa were to be considered the aperture section of the field oxide film, then the alleged penetration electrode 51 does not pass through this opening 27 and the claim would not be met for this reason.

Accordingly, Hayakawa fails to disclose or suggest a hole in the semiconductor substrate (through which the penetration electrode must pass) being formed entirely within an aperture

section of the field oxide film so that an opening of the hole is smaller than the aperture section of the field oxide film as called for in claim 1.

For the foregoing many reasons, the Section 102(e) rejection of claim 1 based on Hayakawa is incorrect and should be reversed.

Claim 2

Claim 2 requires that the penetration electrode is formed in a *field area* of the surface of the semiconductor substrate. The “field area” is clearly defined in the instant specification (e.g., pg. 4, third paragraph). In particular, the instant specification defines a “field area” as “an area where no semiconductor element is provided” (pg. 4, third paragraph). Thus, claim 2 requires that the penetration electrode is formed in an area where no semiconductor element is provided. In contrast, the alleged penetration electrode 51 in Hayakawa is formed in an active area rather than a field area, because 51 is formed above an NMOS or PMOS. Thus, the Section 102(e) rejection of claim 2 is also incorrect and should be withdrawn.

Claim 18

Claim 18 requires “pad electrode formed over the field oxide film so as to overlap the field oxide film when perpendicularly viewing the semiconductor substrate; wherein: the *pad electrode has an aperture section formed therethrough*, the penetration electrode is electrically connected to the pad electrode, *the penetration electrode being provided so as to pass through each of the aperture section of the field oxide film, a hole formed in the semiconductor substrate, and the aperture section of the pad electrode, the hole being formed entirely within the aperture section of the field oxide film, when perpendicularly viewing the semiconductor substrate, so that an opening of the hole is smaller than the aperture section of the field oxide film; and the penetration electrode being formed in a field area of the surface of the semiconductor substrate.*

Hayakawa fails to disclose or suggest at least the aforesaid italicized features of claim 18 as explained above in connection with claims 1 and 2.

Claim 19

Claim 19 requires “a pad electrode, having an *aperture section formed therethrough*, the pad electrode being formed over the field oxide film so as to overlap the field oxide film when perpendicularly viewing the semiconductor substrate; wherein: the penetration electrode is electrically connected to the pad electrode, the *penetration electrode being provided so as to pass through each of the aperture section of the field oxide film, a hole formed in the semiconductor substrate, and the aperture section of the pad electrode, and the hole being formed entirely within the aperture section of the field oxide film, when perpendicularly viewing the semiconductor substrate*, so that an opening of the hole is smaller than the aperture section of the field oxide film. Hayakawa fails to disclose or suggest the aforesaid italicized features of claim 19, as explained above in connection with claim 1.

Claim 28

Claim 28 requires “a penetration electrode electrically connected to the pad electrode, the *penetration electrode being provided so as to pass through each of the aperture section of the field oxide film, and a hole formed in the semiconductor substrate, and wherein the hole in the semiconductor substrate is formed entirely within the aperture section of the field oxide film, when perpendicularly viewing the semiconductor substrate, so that an opening of the hole is smaller than the aperture section.*” Hayakawa fails to disclose or suggest these features of claim 28, as explained above in connection with claim 1.

B. § 103(a) Rejection Based on Hayakawa/Finnila (claims 5-6, 8, 22, 24-26)

Independent claims 1, 18, 19 and 28 define over the cited art for the reasons discussed above. Because these claims are allowable, so are the claims dependent thereon.

Claim 5

Furthermore, claim 5 requires that an insulation film is formed on an internal surface of the hole between the internal surface of the hole and a sidewall of the penetration electrode.

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Hayakawa and Finnila fail to disclose or suggest this feature. It is not clear which feature of Hayakawa the Examiner contends corresponds to the hole in the substrate. Even assuming that Hayakawa and Finnila were combined (which applicant believes would be incorrect in any event), there still is no teaching or suggestion leading one to form an insulation film is formed on an internal surface of the hole between the internal surface of the hole and a sidewall of the alleged penetration electrode 51 as required by claim 5, especially because the semiconductor substrate 1 is below element 51 as explained above.

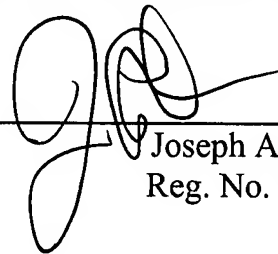
CONCLUSION

In conclusion it is believed that the application is in clear condition for allowance; therefore, early reversal of the Final Rejection and passage of the subject application to issue are earnestly solicited.

Respectfully submitted,

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(VIII) CLAIMS APPENDIX

1. A semiconductor apparatus, comprising:

a semiconductor substrate;

a field oxide film formed over a surface of the semiconductor substrate, the field oxide film having an aperture section;

a pad electrode, having an aperture section formed therethrough, the pad electrode being formed over the field oxide film so as to overlap the field oxide film when perpendicularly viewing the semiconductor substrate; and

a penetration electrode electrically connected to the pad electrode, the penetration electrode being provided so as to pass through each of (a) the aperture section of the field oxide film, (b) a hole formed in the semiconductor substrate, and (c) the aperture section of the pad electrode,

the hole in the semiconductor substrate being formed entirely within the aperture section of the field oxide film, when perpendicularly viewing the semiconductor substrate, so that an opening of the hole is smaller than the aperture section of the field oxide film.

2. The semiconductor apparatus as set forth in claim 1, wherein: the penetration electrode is formed in a field area of the surface of the semiconductor substrate.

3. (Canceled)

4. The semiconductor apparatus as set forth in claim 1, wherein: the aperture section of the field oxide film is formed in the aperture section of the pad electrode, when perpendicularly viewing the semiconductor substrate.

5. The semiconductor apparatus as set forth in claim 1, wherein: an insulating film is formed on an internal surface of the hole between the internal surface of the hole and a sidewall of the penetration electrode.

6. The semiconductor apparatus as set forth in claim 5, wherein: the penetration electrode includes an electrically conductive film on the insulating film that is formed on the internal surface of the hole.

7. The semiconductor apparatus as set forth in claim 1, wherein: the penetration electrode includes a hole-filling section formed in the hole.

8. The semiconductor apparatus as set forth in claim 1, wherein: a hole-filling section is formed in the hole, and the hole-filling section is made of an insulating material.

9. The semiconductor apparatus as set forth in claim 7, wherein: the hole-filling section is made of an electrically conductive material.

10-16. (Canceled)

17. The semiconductor apparatus of claim 1, wherein the pad electrode is formed so that there is no overlap with the hole when perpendicularly viewing the semiconductor substrate.

18. A penetration electrode for use in a semiconductor apparatus, the semiconductor apparatus comprising a semiconductor substrate, a field oxide film formed over a surface of the semiconductor substrate, the field oxide film having an aperture section that is an opening

through the field oxide film, and a pad electrode formed over the field oxide film so as to overlap the field oxide film when perpendicularly viewing the semiconductor substrate; wherein:

the pad electrode has an aperture section formed therethrough,

the penetration electrode is electrically connected to the pad electrode, the penetration electrode being provided so as to pass through each of the aperture section of the field oxide film, a hole formed in the semiconductor substrate, and the aperture section of the pad electrode,

the hole being formed entirely within the aperture section of the field oxide film, when perpendicularly viewing the semiconductor substrate, so that an opening of the hole is smaller than the aperture section of the field oxide film; and

the penetration electrode being formed in a field area of the surface of the semiconductor substrate.

19. A penetration electrode for use in a semiconductor apparatus, the semiconductor apparatus comprising:

a semiconductor substrate,

a field oxide film formed over a surface of the semiconductor substrate, the field oxide film having an aperture section that is an opening through the field oxide film,

a pad electrode, having an aperture section formed therethrough, the pad electrode being formed over the field oxide film so as to overlap the field oxide film when perpendicularly viewing the semiconductor substrate; wherein:

the penetration electrode is electrically connected to the pad electrode, the penetration electrode being provided so as to pass through each of the aperture section of the field oxide film, a hole formed in the semiconductor substrate, and the aperture section of the pad electrode, and

the hole being formed entirely within the aperture section of the field oxide film, when perpendicularly viewing the semiconductor substrate, so that an opening of the hole is smaller than the aperture section of the field oxide film.

20. The penetration electrode of claim 19, wherein the aperture section of the field oxide film is formed in the aperture section of the pad electrode, when perpendicularly viewing the semiconductor substrate.

21. The semiconductor apparatus of claim 4, wherein the aperture section in the pad electrode is larger than the aperture section in the field oxide film, when perpendicularly viewing the semiconductor substrate.

22. The semiconductor apparatus of claim 5, wherein the insulating film is in direct contact with the field oxide film.

23. The semiconductor apparatus of claim 1, wherein the pad electrode is formed directly on and contacting the field oxide film.

24. The semiconductor apparatus of claim 1, wherein the penetration electrode extends through the aperture section of the pad electrode so that the penetration electrode is located at elevations both above and below the pad electrode.

25. The penetration electrode of claim 18, wherein the penetration electrode extends through the aperture section of the pad electrode so that the penetration electrode is located at elevations both above and below the pad electrode.

26. The penetration electrode of claim 19, wherein the penetration electrode extends through the aperture section of the pad electrode so that the penetration electrode is located at elevations both above and below the pad electrode.

27. The semiconductor apparatus of claim 1, wherein the aperture section of the pad electrode is a hole formed through the pad electrode, such that the aperture section is surrounded by the pad electrode when perpendicularly viewing the semiconductor substrate.

28. A semiconductor apparatus, comprising:
a semiconductor substrate;
a field oxide film formed over a surface of the semiconductor substrate, the field oxide film having an aperture section;

a pad electrode formed over the field oxide film so as to overlap the field oxide film when perpendicularly viewing the semiconductor substrate; and

a penetration electrode electrically connected to the pad electrode, the penetration electrode being provided so as to pass through each of the aperture section of the field oxide film, and a hole formed in the semiconductor substrate, and

wherein the hole in the semiconductor substrate is formed entirely within the aperture section of the field oxide film, when perpendicularly viewing the semiconductor substrate, so that an opening of the hole is smaller than the aperture section.

(IX) EVIDENCE APPENDIX

None

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(X) **RELATED PROCEEDINGS APPENDIX**

None